

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

TCI 3371 – COMPUTATIONAL INTELLIGENCE II
(All sections / Groups)

17 October 2016
9:00am – 11:00am
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of **FIVE** pages, which includes the front cover, with **FOUR** Questions only.
2. Attempt **FOUR** questions: All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided, and start each question on a new page.

Question 1 [10 marks]

- (a) Genetic algorithm was applied by Hillis (1990) to evolve sorting networks. The sorting networks were defined in terms of diploid chromosomes. Each chromosome contained eight 4-bit "codons" indicating an integer between 0 and 15. An example of diploid chromosomes (A and B) in 4 positions is given below:

A	1111	0011	0111	1010	0101	1000	1001	0101
B	1111	0011	0111	1010	0111	1100	1001	0101

- (i) Explain and then demonstrate how a comparison could be made among the codon pairs of chromosomes A and B. [2 marks]
- (ii) How many *homozygous* and *heterozygous* positions contained in the chromosome pair A and B? [1 mark]
- (iii) What is the total number of comparisons? [1 mark]

Reference:

Hillis, W.D. 1990. Co-evolving parasites improve simulated evolution as an optimisation procedure. *Physica D* 42:228-234.

- (b) How an genetic algorithm can be applied to evolve an artificial neural network? List three ways. [3 marks]
- (c) The grammatical rules for generating a network are given as follows.

$$\begin{array}{l}
 S \rightarrow \begin{array}{cc} M & N \\ P & Q \end{array} \quad M \rightarrow \begin{array}{cc} a & e \\ a & a \end{array} \quad N \rightarrow \begin{array}{cc} f & a \\ d & b \end{array} \quad P \rightarrow \begin{array}{cc} a & a \\ a & a \end{array} \quad Q \rightarrow \begin{array}{cc} a & c \\ a & a \end{array} \\
 a \rightarrow \begin{array}{cc} 0 & 0 \\ 0 & 0 \end{array} \quad b \rightarrow \begin{array}{cc} 0 & 0 \\ 1 & 0 \end{array} \quad c \rightarrow \begin{array}{cc} 1 & 0 \\ 0 & 1 \end{array} \quad d \rightarrow \begin{array}{cc} 1 & 1 \\ 0 & 0 \end{array} \quad e \rightarrow \begin{array}{cc} 0 & 1 \\ 0 & 1 \end{array} \\
 f \rightarrow \begin{array}{cc} 1 & 0 \\ 1 & 1 \end{array}
 \end{array}$$

- (i) What is the representation in a connection matrix? [2 marks]
- (ii) By referring to the representation from (i), draw a network. [1 mark]

Continued.....

Question 2 [10 marks]

(a) Two mathematical formulas are given as follows:

(1) $\cos(a) - a^3$

(2) $\tan(a) * \exp(a)$

(i) Write each of the formulas above in form of a LISP program.

[1 mark]

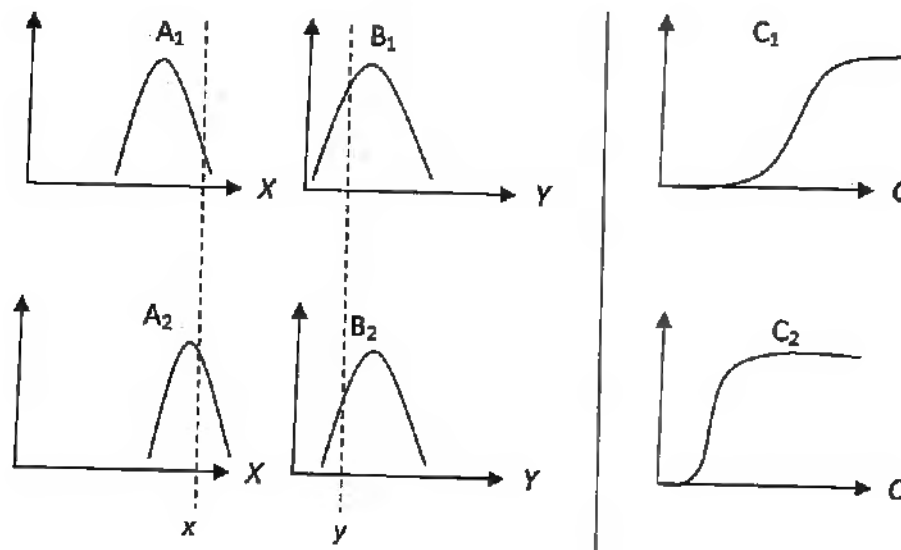
(ii) What is the representation of each program in a(i) in form of a parse tree?

[2 marks]

(iii) Illustrate how the two parse trees from a(ii) can produce two new parse trees through a crossover process. You should indicate the location of crossover at each parent tree.

[4 marks]

(b) A Tsukamoto fuzzy model is illustrated in the figure below. Illustrate, by completing the figure, how defuzzification could be performed to estimate an outcome given inputs x and y to the fuzzy model?



[3 marks]

Continued.....

Question 3 [10 marks]

(a) Explain the following terminologies:

(i) Darwin's sexual selection

(ii) Natural selection

[2 marks]

Then, state a similarity between the Darwin's sexual selection and the natural selection.

[1 mark]

[1 mark]

(b) A solution of genetic algorithm could be represented using either binary encoding or tree encoding. Discuss the advantages and disadvantages of binary encoding and tree encoding.

[4 marks]

(c) What are the advantages of using a two-point crossover operator as compared to a single-point crossover?

[2 marks]

Continued.....

Question 4 [10 marks]

- (a) Explain the following two terminologies:
- (i) Implicit parallelism [2 marks]
 - (ii) Deception in genetic algorithm [2 marks]
- (b) Apart from genetic algorithm, what are another two common approaches to modeling natural evolution? [2 marks]
- (c) What are the four characteristics of an ideal genetic algorithm? [4 marks]

End of Paper